

# ArAS News

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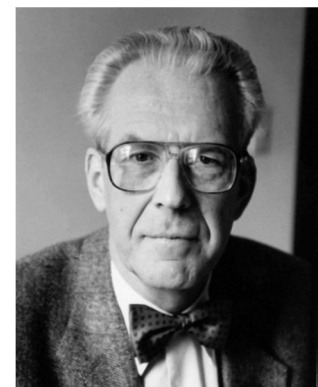
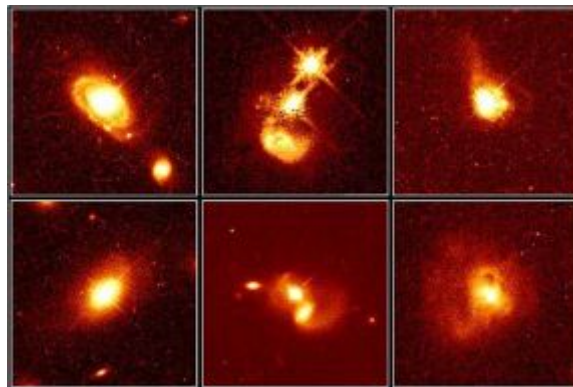
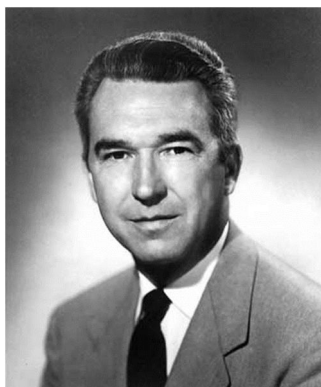
## RENOVATION of BAO 2.6m TELESCOPE

BAO 2.6m (the largest) telescope was installed in 1975 and started its observations in 1976. Later the mirror was substituted by a better one; however it was not aluminized since 1980s. Though an aluminization plant was built in Byurakan in mid-1980s, it didn't work due to desintegration of the Soviet Union and the economic crisis. In addition, the telescope had a number of other technical problems, mainly related to the electronics and control. That was why, until recently, the 2.6m telescope could not work enough efficiently. After BAO was awarded a status of National Value by the Armenian Government, additional funding was allocated, which in 2013 was completely used for the renovation of the 2.6m telescope. The Presidium of the Armenian National Academy of Sciences was supervising these works and the "Galaxy" company was accomplishing the project. After several months of work, the 2.6m mirror was aluminized and reinstalled on Sep 2013.



On Nov 9, the President of Armenia Mr. Serzh Sargsyan visited BAO to see the results. Beside the aluminization of the mirror, some more modernization works are planned, such as the substitution of the analogous system of the control by its digital version, purchase of new receivers, etc.

## SEYFERTs – 70 and QSOs – 50 ANNIVERSARIES



This year we have two anniversaries related to AGN discoveries: 70 years of the publication by Carl Seyfert in 1943 (first Seyfert galaxies and first AGN) and 50 years of the discovery of quasars by Maarten Schmidt in 1963. These two kinds of objects are among the most important types of

AGN. As later it was found, Seyferts were quite similar to QSOs by their physical properties and often both are considered as the early stage of evolution of galaxies. Viktor Ambarstumian was the first to understand the importance of the galactic nuclei and their activity (Ambarstumian 1954; 1956; 1958) and search and studies of AGN are the basis of the research subjects of BAO. The discovery of Markarian galaxies (Markarian et al. 1989) containing many Seyferts and other types of AGN promoted the extended studies of AGN in general.

In 1943 Carl Seyfert (1911-1960) published spectra of 6 galaxies (extragalactic nebulae) with unusually broad high-excitation nuclear emission lines: NGC 1068, NGC 1275, NGC 3516, NGC 4051, NGC 4151, and NGC 7469, the Doppler widths reaching up to 8500 km/sec (Seyfert 1943). However, this work was not given enough importance during the next years and only later these galaxies were called Seyfert galaxies. In 1963 Maarten Schmidt (b. 1929) using the Palomar 5m telescope among the star-like radio sources discovered the farthest objects of the Universe: quasars (Quasi-Stellar Objects, QSOs; Schmidt 1963). Radiosource 3C 273 was the first quasar, and later 3C 48 and others were identified. Quasars and Seyfert galaxies at present are the fundamental part of astrophysics and cosmology and are in the basis of the theory of black holes, which are directly connected to the origin and evolution of stars and galaxies.

Armenian astronomers also have large contribution in discovery of many new quasars, especially bright ones; the Second Byurakan Survey (SBS, Markarian et al. 1983, Stepanian 2005), the First Byurakan Survey QSOs (Mickaelian et al. 2001), the FIRST/APM QSO Survey (FAQS, Chavushyan et al. 2002), QSOs from identification of ROSAT sources (Véron-Cetty et al. 2004, Mickaelian et al. 2006), etc. Hundreds of new bright quasars have been discovered from the Byurakan surveys, FIRST and ROSAT sources.

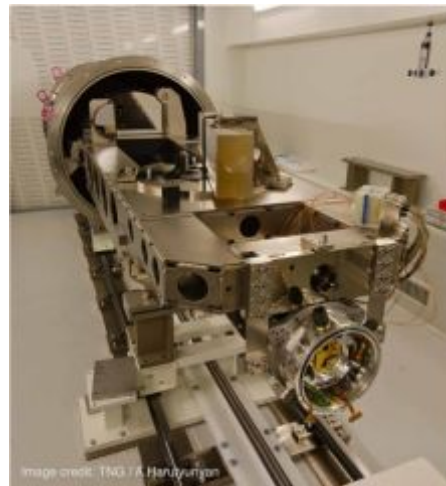
At present some 300,000 QSOs and Seyferts are known if combined from Véron-Cetty and Véron (2010) catalog, SDSS DR9 (Adelman-McCarthy et al. 2012) and DR10 (Ahn et al. 2013, DR10 QSO catalog Pâris et al. 2013). However, most of them only have statistical importance. Out of these objects only a few thousands are enough bright and the discovery of each bright QSO is important for understanding their physical properties, multiwavelength characteristics and evolution.

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## KEPLER-78B – an EARTH-LIKE PLANET

Kepler-78b is an extra solar planet orbiting a Sun-like star located in the constellation of Cygnus, some 400 light-years away from Earth. So far, the astronomers have characterized more than 1000 exoplanets, but Kepler-78b is a special one. According to the study published today in the Nature magazine, it has a mass and density very similar to those of the Earth. The authors of the study, an international team of astronomers led by Francesco Pepe of the Geneva University and the team members coming from various institutions of Switzerland, Italy, UK and USA, show that Kepler-78b is made of rock and iron, just like our Earth. Thus, Kepler-78b is now the smallest exoplanet for which the mass and radius are known accurately.



Left: Artist's impression of the Kepler-78b. Image credit: TNG / A. Harutyunyan  
Right: The HARPS-N spectrograph. Image credit: TNG / A. Harutyunyan

Kepler-78b was first spotted by the NASA's Kepler satellite. Kepler detected the tiny variation of the host star's light caused by the passage of the planet in front of it. Shortly after the discovery, the Italian Telescopio Nazionale Galileo (TNG)<sup>1</sup> in La Palma, Canary Islands, pointed the planet's star. Indeed, the science team of HARPS-N<sup>2</sup>, one of the world's most precise spectrographs, mounted on the TNG, decided to focus on the observations of the Kepler-78b. A very intense observational campaign during the spring-summer months gave its fruits. Exploiting the unique characteristics and accuracy of the HARPS-N, the team measured the slight wobble of the host star caused by the exoplanet orbiting it. It was showed that the planet has Earth-like mass and density.

**Young Armenian astronomer Avet Harutyunyan** works at the TNG and is one of the coauthors of the study. *"It was clear that we had to detect an extremely small wobble caused by a tiny planet. HARPS-N at the TNG is the most precise spectrograph in the northern hemisphere, so what other instrumentation was up to the task if not ours",* explains Harutyunyan. Then he adds: *"Right now these are the most precise results that could be obtained and we were happy to see how well our instruments faired in these challenging observations".*

Kepler-78b has a radius of only 1.17 times that of the Earth, while the mass is 1.86 Earth masses. These numbers yield a density of 5.57 grams per cubic centimeter, and imply a composition of rock and iron, thus making Kepler-78b the most Earth-like exoplanet known so far. However, Kepler-78b has a very short orbital period of only 8.5 hours and therefore it orbits at a close distance from its host star. This means that the temperature on the surface of the planet should be somewhere between 3000 and 5000 degrees, effectively ruling out any possibility of life as we imagine it.

The Kepler-78b is destined to vanish, since the tidal forces will continuously draw it closer to its star. Eventually it will move so close that the star's gravity will rip the planet apart. This may happen within three billion years, the theorists predict. *"Interestingly, our solar system could have*

*had a planet like Kepler-78b. If it had, the planet would have been destroyed early during the system evolution, leaving no signs today”, says Avet Harutyunyan.*

Even if without any possibility of hosting life, the discovery and characterization of Kepler-78b, a planet of Earth-like dimensions, density and composition, is a big step forward in our search of extraterrestrial life. HARPS-N will produce more amazing results, allowing us to obtain an increasingly complete picture of the exoplanets formation and evolution, and one day we may possibly find a habitable planet with Earth-like characteristics.

*1 – The Italian 3.58m Telescopio Nazionale Galileo (TNG) is located at the Roque de los Muchachos Observatory, La Palma, Canary Islands. The TNG is operated by the Fundación Galileo Galilei – INAF (FGG-INAF).*

*2 – HARPS-N is the northern hemisphere copy of the successful HARPS instrument, with identical characteristics and performance. HARPS-N is thus the most precise spectrograph measuring stellar velocities in the northern sky. HARPS-N is installed at the TNG and is led by an international Consortium of the Geneva University, TNG-INAF, Harvard-Smithsonian CfA, University of St. Andrews, University of Edinburgh and Queens University Belfast.*

## ArAS PRIZE for YOUNG ASTRONOMERS (YERVANT TERZIAN PRIZE)



**December 1** is the **deadline** for applications for **ArAS Annual Prize for Young Astronomers (Yervant Terzian Prize) 2013**.

The prize will be awarded to a young scientist under 35 working in astronomy or related field and showing significant results in research and/or other scientific activities connected anyhow with the Armenian astronomy. **Nominations** may be made by ArAS

members or any research organization from Armenia or elsewhere and should be sent to one of the ArAS Co-Presidents. They should include personal data for the nominee and a brief description of his/her achievements during the year, including important scientific results, all published papers, participation in meetings, given talks, and any other activities, whatever is considered to be important. At least one refereed publication is required to qualify for the Prize.

The winner will be announced in the last issue of ArAS Newsletter (#68) at the end of the year. A **diploma** and sum of **\$500** will be awarded to the winner.

The Prize was established in 2004 and is being sponsored by one of ArAS Co-Presidents **Prof. Yervant Terzian** (Cornell University, USA). Since 2009 the Prize is named after Yervant Terzian. Altogether, 9 young astronomers have been winners (in some years the Prize was shared between two astronomers), including Lusine Sargsyan, Vardan Adibekyan and Parandzem Sinamyanyan; each of them twice has become winner.



## ASTRONOMICAL MEETINGS in ARMENIA

The recent IAU Symposium #304 was one of the largest events in the history of the Armenian science as for its importance, so as for the number of countries and participants represented. It was the 6<sup>th</sup> IAU meeting in Armenia (5 IAU symposia and 1 IAU colloquium have been held). Byurakan and other Armenian scientists have organized many other important astronomical meetings as well, most of them led by our greatest scientist Viktor Ambartsumian. Several series of meetings have been traditionally held, such as:

- IAU meetings (1966, 1986, 1989, 1998, 2001, 2013)
- Meetings on Non-Stable Stars and Stellar Associations (1951, 1956, 1976, 1979, 1984, 1989)
- Meetings on Extraterrestrial Civilizations (1964, 1971)
- French-Armenian astronomical colloquia (1995, 2009)
- Joint Armenian-Georgian (Byurakan-Abastumani) colloquia (1974, 1977, 1979, 1983, 1985, 1988, 1998, 2003, 2013)
- ArAS annual meetings (2002-2012)
- Meetings dedicated to anniversaries (1968, 1978, 1981, 1988, 1996, 1998, 2006, 2008, 2012)
- Conferences for young astronomers (1978, 1988, 2011)
- Byurakan International Summer Schools (BISS) (1987, 2006, 2008, 2010, 2012)



Most important meetings (top-20) probably were the following ones:

- 1951, Nov 12-16, STELLAR ASSOCIATIONS, Conference of the Astronomical Council of the USSR Academy of Sciences
- 1956, Sep 20-22, NON-STABLE STARS, Symposium dedicated to the Official Inauguration of BAO
- 1966, May 4-12, IAU Symposium #29: NON-STABLE PHENOMENA IN GALAXIES
- 1968, Sep 16-19, STARS, NEBULAE, GALAXIES, Symposium dedicated to V.A. Ambartsumian's 60<sup>th</sup> anniversary
- 1971, Sep 6-11, COMMUNICATION WITH EXTRATERRESTRIAL INTELLIGENCE, First International Symposium on the Problem of Extraterrestrial Civilizations
- 1976, Oct 5-8, FLARE STARS, International Symposium dedicated to the Official Opening of the 2.6m telescope

- 1979, May 22-24, FLARE STARS, FUORS AND HERBIG-HARO OBJECTS, Symposium of the Multilateral Research Cooperation of the Academies of Sciences of the Socialist Countries on the Problem of "Stellar Physics and Evolution"
- 1981, Oct 26-30, PRINCIPLE OF INVARIANCE AND ITS APPLICATIONS, All-Union Symposium dedicated to the 40<sup>th</sup> anniversary of the Principle of Invariance Introduction to the Radiation Transfer Theory
- 1984, Oct 16-19, FLARE STARS AND RELATED OBJECTS, International Symposium
- 1986, June 3-7, IAU Sympoisum #121: OBSERVATIONAL EVIDENCE OF ACTIVITY IN GALAXIES
- 1987, Sep 22-28, OBSERVATIONS WITH LARGE TELESCOPES, ESO-BAO International School for Young Astronomers
- 1989, Oct 23-27, IAU Sympoisum #137: FLARE STARS IN STAR CLUSTERS, ASSOCIATIONS AND SOLAR VICINITY
- 1996, Oct 4-9, INSTABILITY PHENOMENA AND THEIR ROLE IN THE EVOLUTION OF COSMIC OBJECTS, International Symposium dedicated to the 50<sup>th</sup> anniversary of BAO
- 1998, Aug 17-21, IAU Sympoisum #194: ACTIVITY IN GALAXIES AND RELATED PHENOMENA, dedicated to V.A. Ambartsumian's 90<sup>th</sup> anniversary
- 2001, June 18-22, IAU Colloquium #184: AGN SURVEYS, dedicated to B.E. Markarian's memory
- 2006, Sep 1-3, ACTIVE UNIVERSE, International Meeting dedicated to the 60<sup>th</sup> anniversary of BAO
- 2007, Aug 20-25, Joint European and National Astronomical Meeting (JENAM-2007): OUR NON-STABLE UNIVERSE
- 2008, Sep 15-18, EVOLUTION OF COSMIC OBJECTS THROUGH THEIR PHYSICAL ACTIVITY, International Conference dedicated to V.A. Ambartsumian's 100<sup>th</sup> anniversary
- 2010, Sep 12 – Oct 2, 3<sup>rd</sup> Byurakan International Summer School (3BISS) combined with the IAU International School for Young Astronomers (ISYA-2010)
- 2013, Oct 7-11, IAU Sympoisum #304: Multiwavelength AGN Surveys and Studies, dedicated to B.E. Markarian's 100<sup>th</sup> anniversary



As it is seen from the table, if not counting JENAM-2007 (which was not a single meeting but the General Assembly of the European Astronomical Society), the recently organized IAU Symposium #304 was the largest astronomical meeting in Armenia by the number of participants (128) and countries (28), and by the number of presented contributions (80).

## Comparative table of astronomical meetings held in Armenia

Meetings	Year	Subject	Participants			Countries	Talks		
			Arm	Foreign	Total		Invited	Contrib.	Total
IAU S29	1966	AGN	17	50	67	12	5	25	30
Stars, Nebulae, Galaxies	1968	General	30	25	55	3	3	39	42
CETI-1971	1971	CETI	9	45	54	5	7	25	32
Flare Stars (FS)	1976	Stars	17	31	48	11	2	26	28
FS, Fuors and HH Objects	1979	Stars	20	52	72	7	0	48	48
Principle of Invariance	1981	Theory	20	45	65	8	3	43	46
FS and Related Objects	1984	Stars	29	31	60	7	1	40	41
IAU S121	1986	AGN	22	91	113	17	11	23	34
ESO-BAO School	1987	General	10	24	34	11	12	0	12
IAU S137	1989	Stars	33	60	93	17	8	42	50
BAO-50	1996	General	40	18	58	6	18	17	35
IAU S194	1998	AGN	30	70	100	22	27	25	52
IAU C184	2001	AGN	25	67	92	16	27	15	42
BAO-60	2006	General	37	35	72	14	1	25	26
JENAM-2007	2007	General	87	169	256	31	85	157	242
VA-100	2008	General	55	34	89	12	11	25	36
ISYA-2010	2010	General	20	48	68	21	19	21	40
IAU S304	2013	AGN	18	110	128	28	28	52	80



A full database of all astronomical meetings held in Armenia is given at ArAS webpage at <http://www.aras.am/BAO/meetings.html>

*Areg Mickaelian*



## 60 YEARS of the IAU SYMPOSIA



The history of the International Astronomical Union (IAU) meetings goes back to 1922 when the IAU I General Assembly (GA) was held in Rome, Italy, following the IAU creation in 1919. However, until 1953, no individual symposia were organized and GA was the only official gathering for astronomers. Altogether, 8 IAU GA were held during 1922-1952.

The IAU Symposium #1 on “*Co-ordination of Galactic Research*” was held during June 17-22, 1953 in Groningen, Netherlands followed by another one (IAU Symp. #2: “*Gas Dynamics of Cosmic Clouds*”) on July 6-11 in Cambridge, UK. Starting with 1955, regularly several IAU symposia were held in different places, as well as since 1959 IAU began to also organize colloquia to discuss relatively smaller topics. 20 IAU colloquia numbered as ## I-XX were held in 1959-1971, and another series of IAU colloquia was organized in 1968-2005, numbered as ## 1-200. At present IAU symposia are the only official scientific meetings, 9 of them organized every year. IAU S304 “*Multiwavelength AGN Surveys and Studies*” held in Armenia is the last one so far. Thus, IAU has a 60-year history of symposia and altogether 304 such meetings have been held, in average 5 ones annually.

At present most of the IAU symposia during the years of GA are being organized in frame of the GA, typically 6 symposia during each GA. This was the case during the GA in 1994 (Hague, Netherlands), 1997 (Kyoto, Japan), 2000 (Manchester, UK), 2003 (Sydney, Australia), 2006 (Prague, Czech Republic) and 2009 (Rio de Janeiro, Brazil). 8 IAU symposia were held during the GA XXVIII in Beijing (2012). Altogether, 29 IAU GA have been organized during 1922-2012, including 28 regular ones and 1 Extraordinary (1973 in Warsaw, Poland), typically once per 3 years.

Since 1974, IAU has also organizes regional meetings in Europe, Asia and Pacific (APRIM, Asian-Pacific Regional IAU Meeting), Latin America (LARIM, Latin-American Regional IAU Meeting), and Middle East and Africa (MEARIM, Middle East and African Regional IAU Meeting). The European ones were discontinued in 1990 after the creation of the European Astronomical Union (EAS) and organization of the yearly JENAMs (at present EWASS – European Week of Astronomy and Space Science). The three others, APRIM (since 1978), LARIM (since 1978), and MEARIM (since 2008) are being organized every 2 or 3 years. Altogether 38 regional meetings have been organized.

As mentioned, 304 IAU symposia have been held on various topics of astronomy and astrophysics. The most often subjects were: various matters related to Stars (37), various Astrophysical Processes (28), Galaxies (27), Cosmology (17), Sun (17, including Solar Activity 7), Solar System (16), Star Formation and Evolution (15), Instrumentation and Methods (14), Multiwavelength Astronomy (Gamma-ray, X-ray, UV, IR and Radio; 13), AGN (10), Exoplanets and SETI (9), Our Galaxy (9), Planetary Nebulae (9), Astrochemistry (8), Binary Stars (8), Interstellar Medium (8), Astrometry (7), Earth (7), Fundamental Astronomy (6), Magnetic Fields (6), Star Clusters (6), Magellanic Clouds (5), Neutron Stars and Pulsars (5), Wolf-Rayet Stars (5), Supernovae (4), and Astronomical Surveys (4).

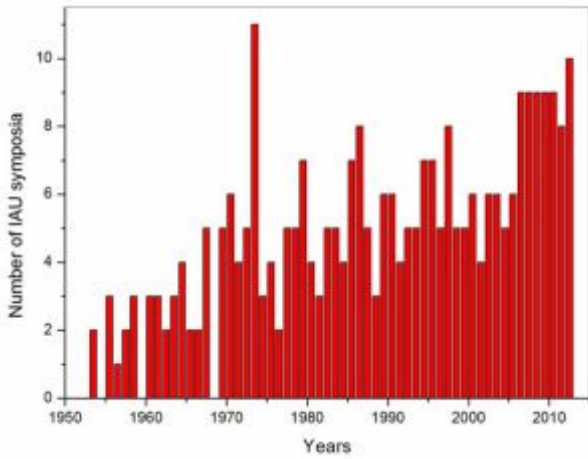


Fig. 1

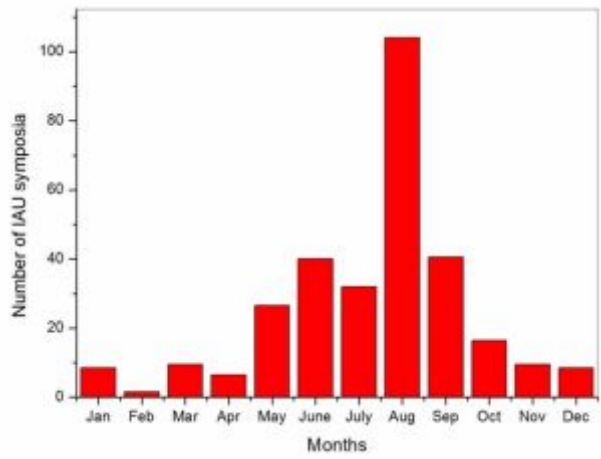


Fig. 2

The distribution of the IAU symposia by years is given in Figure 1. An increase in numbers is clearly seen. The distribution by months is given in Figure 2. Most often (104) IAU symposia have been held in August, mainly connected to the IAU GA. Only 1 symposium (and a part of another one) has been held in February. The 304 meetings have been organized in 43 countries; most often in the USA (42), France (23), Australia (20), China (18), Italy (18), UK (18), Germany (14), Netherlands (14), Brazil (13), Japan (13), Canada (9), Switzerland (9), Russia (8), Spain (8), Argentina (6), Czech Republic (6), Poland (6), Sweden (6), Armenia (5), and India (5). Altogether, 171 cities and towns have been hosts for the IAU symposia, most often Paris (12), Beijing (10), Sydney (9), Rio de Janeiro (8), Kyoto (7), Prague (7), The Hague (6), Geneve (5), St. Petersburg (5), Manchester (5), Byurakan (4), Cambridge, MA (4), Canberra (4), Heidelberg (4), and Tokyo (4).

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